



National  
Qualifications  
2024

**X847/76/11**

**Mathematics  
Paper 1 (Non-calculator)**

MONDAY, 13 MAY  
9:00 AM – 10:15 AM



**Total marks — 55**

Attempt ALL questions.

**You must NOT use a calculator.**

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

You will not earn marks for answers obtained by readings from scale drawings.

Write your answers clearly in the spaces provided in the answer booklet. The size of the space provided for an answer is not an indication of how much to write. You do not need to use all the space.

Additional space for answers is provided at the end of the answer booklet. If you use this space you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give your answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.



\* X 8 4 7 7 6 1 1 \*

## FORMULAE LIST

### Circle

The equation  $x^2 + y^2 + 2gx + 2fy + c = 0$  represents a circle centre  $(-g, -f)$  and radius  $\sqrt{g^2 + f^2 - c}$ .

The equation  $(x - a)^2 + (y - b)^2 = r^2$  represents a circle centre  $(a, b)$  and radius  $r$ .

### Scalar product

$\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}| |\mathbf{b}| \cos \theta$ , where  $\theta$  is the angle between  $\mathbf{a}$  and  $\mathbf{b}$

or  $\mathbf{a} \cdot \mathbf{b} = a_1 b_1 + a_2 b_2 + a_3 b_3$  where  $\mathbf{a} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix}$  and  $\mathbf{b} = \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$ .

### Trigonometric formulae

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A$$

$$= 2 \cos^2 A - 1$$

$$= 1 - 2 \sin^2 A$$

### Table of standard derivatives

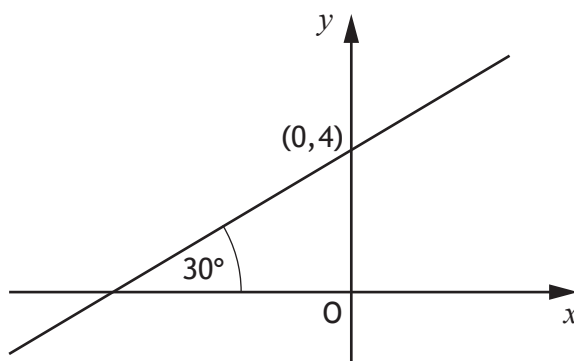
$f(x)$	$f'(x)$
$\sin ax$	$a \cos ax$
$\cos ax$	$-a \sin ax$

### Table of standard integrals

$f(x)$	$\int f(x) dx$
$\sin ax$	$-\frac{1}{a} \cos ax + c$
$\cos ax$	$\frac{1}{a} \sin ax + c$

Total marks — 55  
Attempt ALL questions

1. A line passes through the point  $(0, 4)$  and makes an angle of  $30^\circ$  with the positive direction of the  $x$ -axis as shown in the diagram.



Determine the equation of the line.

3

2. A sequence is defined by the recurrence relation  $u_{n+1} = \frac{1}{5}u_n + 12$  with  $u_1 = 20$ .

(a) Calculate the value of  $u_2$ .

1

(b) (i) Explain why this sequence approaches a limit as  $n \rightarrow \infty$ .

1

(ii) Calculate this limit.

2

3. Given that  $y = (5x^2 + 3)^7$ , find  $\frac{dy}{dx}$ .

2

4. P and Q have coordinates  $(-6, 1, 2)$  and  $(-1, 11, -8)$  respectively.

Find the coordinates of the point R which divides PQ in the ratio 2:3.

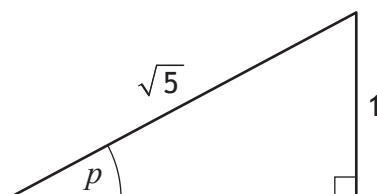
2

[Turn over

5. A function,  $h$ , is defined by  $h(x) = 2x^3 - 7$  where  $x \in \mathbb{R}$ .  
Find the inverse function,  $h^{-1}(x)$ .

3

6. The right-angled triangle in the diagram is such that  $\sin p = \frac{1}{\sqrt{5}}$  and  $0 < p < \frac{\pi}{4}$ .



- (a) Determine the value of:

(i)  $\sin 2p$

3

(ii)  $\cos 2p$ .

1

- (b) Hence determine the value of  $\sin 4p$ .

1

7. The line  $y = 2x$  is a tangent to the circle with equation  $x^2 + y^2 - 14x - 8y + 45 = 0$ .  
Determine the coordinates of the point of contact.

4

8. The equation  $x^2 + (m-4)x + (2m-3) = 0$  has no real roots.

Determine the range of values for  $m$ .

4

Justify your answer.

9. Express  $\log_a 5 + \log_a 80 - 2\log_a 10$  in the form  $\log_a k$  where  $k$  is a positive integer. 3
10. (a) Show that  $(x-1)$  is a factor of  $2x^4 + 3x^3 - 4x^2 - 3x + 2$ . 2
- (b) Hence, or otherwise, factorise  $2x^4 + 3x^3 - 4x^2 - 3x + 2$  fully. 4
11. (a) Express  $\cos x^\circ + \sqrt{3} \sin x^\circ$  in the form  $k \cos(x-a)^\circ$ , where  $k > 0$  and  $0 < a < 360$ . 4
- (b) Hence, or otherwise, sketch the graph with equation  $y = \cos x^\circ + \sqrt{3} \sin x^\circ$ ,  $0 \leq x \leq 360$ .  
Use the diagram provided in your answer booklet. 3
12. The function  $f$  is given by  $f(x) = 12\sqrt[3]{x}$ ,  $x > 0$ .  
When  $x = a$  the rate of change of  $f$  with respect to  $x$  is 1.  
Determine the value of  $a$ . 4

[Turn over

13. P and Q are the points (4, 10) and (6, 2) respectively.

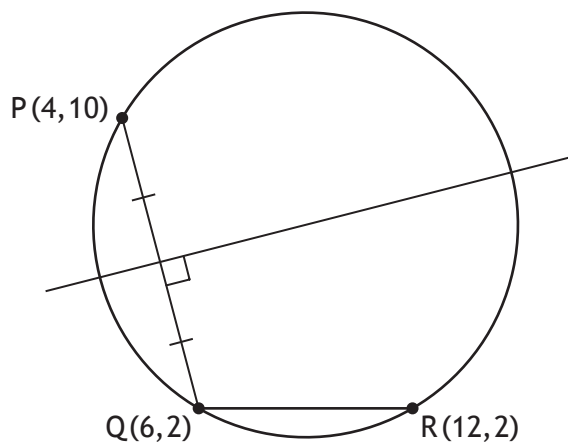
(a) Find the equation of the perpendicular bisector of PQ.

4

The point R has coordinates (12, 2).

A circle passes through the points P, Q and R.

The chord QR is horizontal.



(b) Find the equation of the circle.

4

[END OF QUESTION PAPER]

[BLANK PAGE]

DO NOT WRITE ON THIS PAGE

[BLANK PAGE]

DO NOT WRITE ON THIS PAGE